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Impact of land management on hydrological functioning in cultivated landscapes: a coupled model of functional assessment

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In cultivated landscapes, hydrological functioning is highly influenced by anthropic drivers. Indeed, spatio-temporal patterns in land management affect processes such as run-off or pollutant flow. Reciprocally, at the scale of a cropping season, hydrological functioning of land influences farmers' actions on crops. Consequently, the assessment of the hydrologic impacts of land management needs recognition of the global functioning of the system which requires a close coupling between the modelling of land management actions and hydrological processes.
Most of hydrological models take into account a spatial representation of the landscape mosaic created by land management. However the resolution used for the temporal evolution of this pattern is coarser than the one required by hydrological model which simulate processes over short time steps. Consequently, there is a need for more accurate temporal representation of land management which means an analysis of the crop management systems and the integration of bio-physical feedback mechanisms on management decisions.
We propose an approach for assessing the hydrological impact of crop management system in the specific case of pollutant loading in a perennial crop area, based on the coupling of a distributed hydrological model with a farmer's decision model. This latter model represents land management with decision rules applied by farmers to drive their collection of plots during the whole cropping cycle. It includes agronomic rules based on indicators of the state of the bio-physical system at plot levels as well as work organisation rules at farm level. Different types of crop management system induced by the diversity of farmers are thus represented by different rules set which can be spatially distributed. The spatial pattern in crop management represented by the decision model determines the hydrological functioning of the landscape. A feedback exists since the hydrological processes like the spatio-temporal evolution soil water content influence several farmer decisions like for example the choice of the dates of soil tillage.
An application of the method is realised on a small (1 km^2) Mediterranean catchment cultivated with vineyard with the prospect of providing a tool that can help farmers to evaluate different land management strategies.